SITE HYDROLOGY AND GROUNDWATER MONITORING

Groundwater Monitoring Program Overview

Groundwater at the West Valley Demonstration Project (WVDP or Project) is monitored to comply with all applicable state and federal regulations and to meet the requirements of U.S. Department of Energy (DOE) Order 450.1. The program enables the WVDP to obtain data to determine baseline conditions, to allow the early detection of groundwater contamination, to identify existing and potential groundwater contamination sources and maintain surveillance of these sources, and to provide data for decision-making.

The WVDP's Groundwater Monitoring Plan outlines groundwater characterization, current groundwater sampling requirements, and support of long-term monitoring requirements identified in the Resource Conservation and Recovery Act (RCRA) facilities investigation (RFI) and DOE programs. The Groundwater Protection Management Program Plan provides additional information regarding protection of groundwater from on-site activities.

Geologic History of the West Valley Site

The Western New York Nuclear Service Center (WNYNSC) comprises approximately 3,345 acres (1,354 hectares [ha]) and is located on the Allegheny Plateau near the northern border of Cattaraugus County in Western New York. The 164-acre (66-ha) WVDP site is located within the WNYNSC. Beneath the WNYNSC site is a sequence of Holocene (recent age) and Pleistocene (ice age) sediments filling a steep-sided valley incised in the bedrock. The bedrock is composed of shales and interbedded siltstones of the upper Devonian Canadaway and Conneaut Groups that dip southward at about 5 m/km (Rickard, 1975).

Pleistocene sediments overlying the bedrock typically consist of a sequence of three glacial tills of Lavery, Kent, and possibly Olean age. The tills are separated by stratified fluvio-lacustrine deposits. In the northern part of the site, the Lavery till is capped by coarse-grained alluvial-fluvial deposits.

A summary of site hydrology is presented below. Hydrologic conditions of the site are more fully described in Environmental Information Document, Volume III: Hydrology, Part 4 (West Valley Nuclear Services Co. [WVNSCO], March 1996) and in the RCRA Facility Investigation Report Vol. 1: Introduction and General Site Overview (WVNSCO and Dames & Moore, July 1997).

Surface Water Hydrology of the West Valley Site

The WNYNSC lies within the Cattaraugus Creek watershed, which empties into Lake Erie about 27 miles (43 km) southwest of Buffalo. Buttermilk Creek, a tributary of Cattaraugus Creek, drains most of the WNYNSC and all of the WVDP site.

The WVDP lies within the watershed of Frank's Creek, which is a tributary of Buttermilk Creek and forms the eastern and southern boundary of the WVDP; Quarry Creek, a tributary of Frank's Creek, forms the northern boundary. (See Fig. A-1 [p. A-1].)

Another tributary of Frank's Creek, Erdman Brook, bisects the WVDP into a north and south plateau. The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the U.S. Nuclear Regulatory Commission (NRC)-Licensed Disposal Area (NDA), and the New York State-Licensed Disposal Area (SDA) are located on the south plateau.

Hydrogeology of the West Valley Site

The WVDP site area is underlain by a sequence of glacial tills comprised primarily of clays and silts separated by coarser-grained interstadial sediments. Because the bottommost layer, the Kent till, is less permeable than the other geological units and does not provide a pathway for contaminant movement from the WVDP, it is not discussed here.

The sediments above the Kent till – the Kent recessional sequence, the Lavery till and the intra-Lavery till-sand, and the surficial sand and gravel – are generally regarded as containing all of the potential routes for the migration of contaminants (via groundwater) from the WVDP site. (Figs. 4-1 and 4-2 [*facing page*] show the relative locations of these sediments on the north and south plateaus.) The Lavery till, the Kent recessional sequence, and the Kent till are common to both the north and south plateaus.

The WVDP does not use groundwater for drinking or operational purposes, nor does it discharge effluent directly to groundwater. No public water supplies are drawn from groundwater downgradient of the WVDP or from Cattaraugus Creek downstream of the WVDP. However, groundwater upgradient of the WVDP is used for drinking water by local residents.

Kent Recessional Sequence. The Kent recessional sequence consists of a fine-grained lacustrine unit of interbedded clay and silty clay layers locally overlain by coarse-grained sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern margin of the site where the walls of the bedrock valley intersect the sequence.

Groundwater flow in the Kent recessional sequence is predominantly to the northeast, toward Buttermilk Creek. Hydraulic conductivity testing completed during the last several years indicates a mean value of 2E-01 ft/day (8E-05 cm/sec) or 2.6 in/day. Recharge comes from the overlying Lavery till and in-flow from the bedrock in the southwest, and discharge is to Buttermilk Creek.

Lavery Till. The Lavery till is predominantly an olive-gray, silty clay glacial till with scattered lenses of silt and sand. It underlies both the north and south plateaus and ranges up to 130 feet (40 m) in thickness beneath the active areas of the site, slightly increasing northeastward toward Buttermilk Creek and the center of the bedrock valley. Groundwater flow in the unweathered Lavery till is predominantly vertically downward at a relatively slow rate; recent hydraulic conductivity testing in the Lavery till during the last several years

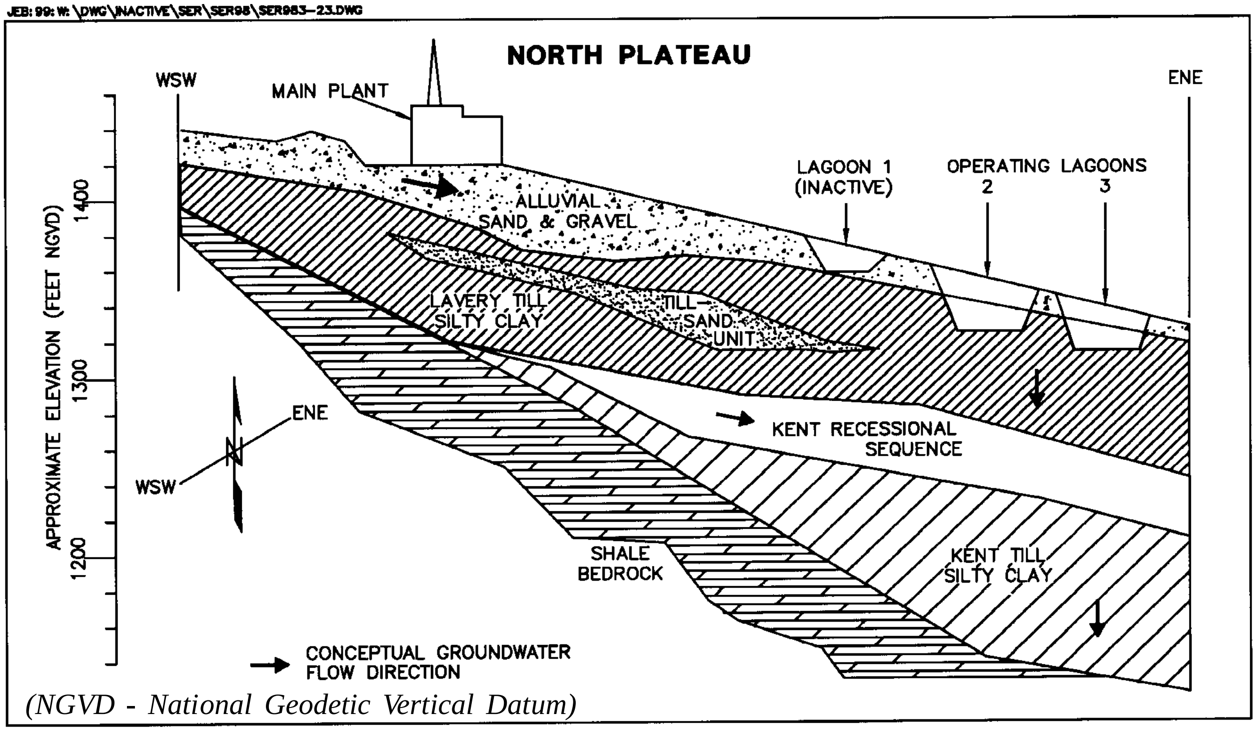

Figure 4-1. Geologic Cross Section Through the North Plateau (Vertical Exaggeration Approx. 2:1)

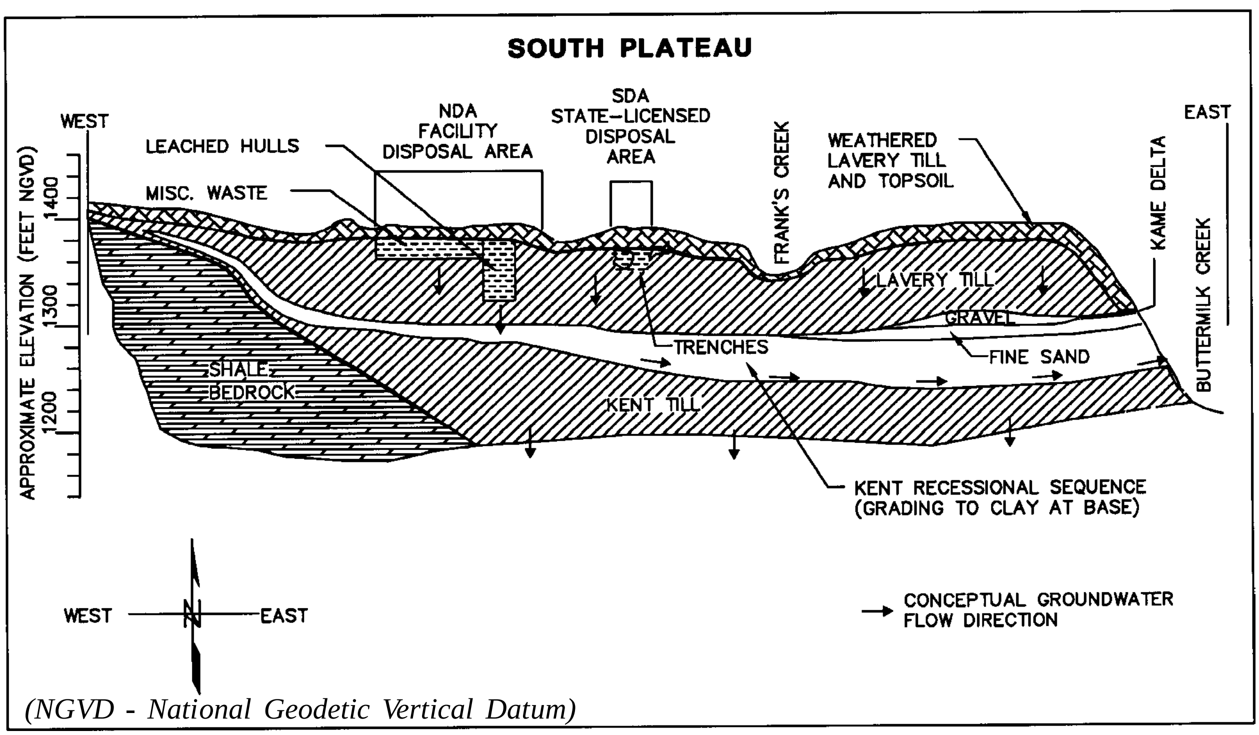

Figure 4-2. Geologic Cross Section Through the South Plateau (Vertical Exaggeration Approx. 2.5:1)

indicates a mean value of approximately 1E-04 ft/day (3.5E-08 cm/sec) or 0.001 in/day. Some wells have produced hydraulic conductivity values as high as 3E-04 cm/sec, which may indicate the presence of sand lenses within the till.

On the south plateau, the upper zone of the Lavery till is exposed at the ground surface and is weathered and fractured to a depth of 3 to 16 feet (0.9 to 4.9 m). This layer is referred to as the weathered Lavery till and is unique to the south plateau. The weathered Lavery till has been oxidized to a brown color and contains numerous desiccation cracks and root tubes.

Groundwater flow in the weathered till has both horizontal and vertical components. This enables groundwater to move laterally across the south plateau before moving downward into the unweathered Lavery till or discharging to nearby incised stream channels. Recent hydraulic conductivity testing in the weathered Lavery till indicates a mean value of 5E-02 ft/day (2E-05 cm/sec) or 0.6 in/day. The highest conductivities are associated with dense fracture zones found within the upper 7 feet (2 m) of the unit.

On the north plateau, the weathered till layer is much thinner or nonexistent and the unweathered Lavery till is overlain by the sand and gravel unit.

Sand and Gravel and Till-Sand Units. The sand and gravel unit and the Lavery till-sand are unique to the north plateau. The sand and gravel unit is a silty sand and gravel layer composed of younger Holocene alluvial deposits that overlie older Pleistocene-age glaciofluvial deposits. Together these two layers range up to 41 feet (12.5 m) in thickness near the center of the plateau and pinch out along the northern, eastern, and southern edges of the plateau, where they have been truncated by downward erosion of stream channels.

Groundwater in this unit generally flows northeastward across the plateau toward Frank's Creek. Groundwater near the northwestern and southeastern margins of the sand and gravel layer also flows radially outward toward Quarry Creek and Erdman Brook, respectively. There is minimal groundwater flow downward into the underlying Lavery till. Mean hydraulic conductivity is 16.4 feet/day (6E-03 cm/sec) or 200 in/day, based on recent testing.

Within the unweathered Lavery till on the north plateau is another unit, the Lavery till-sand. This thin, sandy unit of limited areal extent and variable thickness is found primarily beneath the southeastern portion of the north plateau. Groundwater flows through this unit in an east-southeast direction. Surface discharge locations have not been observed. The mean hydraulic conductivity of 3.8 ft/day (1E-03 cm/sec) or 46 in/day for this unit is based on testing completed during the last several years.

Routine Groundwater Monitoring Program

Groundwater is monitored in the five hydrogeologic units previously described: the sand and gravel, the weathered Lavery till, the unweathered Lavery till, the Lavery till-sand, and the Kent recessional sequence. In 2003, a total of 69 groundwater monitoring locations were sampled. These locations included 63 monitoring wells (including driven well points), five groundwater seepage points, and one sump/manhole. (See Tables 4-1 and 4-2 [*facing page*] for a summary of groundwater monitoring activities in 2003.)

Monitoring Well Network. Most of the routine groundwater monitoring wells were originally assigned to monitor one (or more) of the super solid waste management units (SSWMUs) on the WVDP site. (See RCRA §3008(h) Administrative Order on Consent [p. ECS-4] and *super solid*

Table 4-1
Summary of Groundwater Monitoring Program by Geographic Area; Monitoring Year 2003

NUMBER OF…	TOTAL WVDP*	NORTH PLATEAU	SOUTH PLATEAU	OFF-SITE RESIDENTIAL
Monitoring Points Sampled - Analytical*	79	54	15	10
Monitoring Points - Water Elevations Only	42	26	16	0
Monitoring Events	5	4	4	1
Analyses	1,146	939	158	49
Results	8,295	6,988	1,197	110
Percent of Nondetectable Results	81%	81%	86%	64%
Water Elevation Measurements	400	276	124	0

** Total number of monitoring points sampled includes WVDP on-site (69 wells) and off-site (10 wells).*

Table 4-2
Summary of Groundwater Monitoring Program by Monitoring Purpose; Monitoring Year 2003

NUMBER OF…	REGULATORY/ WASTE MANAGEMENT	ENVIRONMENTAL SURVEILLANCE
Monitoring Points Sampled - Analytical*	34	45
Monitoring Points - Water Elevations Only	0	42
Monitoring Events	4	5
Analyses	271	875
Results	4,936	3,359
Percent of Nondetectable Results	92%	86%
Water Elevation Measurements	128	272

** Total number of monitoring points sampled includes WVDP on-site (69 wells) and off-site (10 wells).*

waste management unit in the Glossary [p. GLO-12].)

Figures A-7 and A-8 (pp. A-7 and A-8) show boundaries of ten of the SSWMUs at the WVDP. Twenty-one additional wells in an eleventh SSWMU monitor the SDA and are the responsibility of the New York State Energy Research and Development Authority (NYSERDA). The SDA, a closed radioactive waste landfill, is contiguous with the Project premises and is owned and managed by NYSERDA. Groundwater monitoring results from the SDA are reported in Appendix L[C] but are not discussed here.

Table E-1[C] in Appendix E lists the 11 SSWMUs monitored by the well network, the hydraulic position of each well relative to the SSWMU, the geologic unit monitored, and the analytes measured in 2003. The wells monitoring a given hydrogeologic unit (e.g., sand and gravel, weathered Lavery till) also are arranged in a generalized upgradient to downgradient order, based upon their location within the entire hydrogeologic unit. The hydraulic position of a well relative to an SSWMU (upgradient or downgradient) is independent of the same well's position within its hydrogeologic unit. For example, a well that is upgradient in relation to an SSWMU may be located at any position within its hydrogeologic unit within the boundaries of the WVDP, depending on the geographic position of the SSWMU relative to the hydrogeologic unit. Note that monitoring of certain wells, marked by an asterisk, was specified in RFI reports prepared in accordance with the RCRA §3008(h) Administrative Order on Consent for the WVDP.

Potentiometric (water level) measurements also are collected from wells listed in Table E-1[C] in conjunction with the quarterly analytical sampling schedule. (See Appendix E[C] [p. E-3].) Groundwater elevation data are used to produce groundwater contour maps, which delineate flow directions and gradients, and long-term trend graphs, which illustrate seasonal fluctuations and other changes in the groundwater system. In 2003, water levels were routinely measured at 42 locations in addition to those that were sampled.

Surface water elevation measurements are also collected at 11 locations on the north plateau where the water table in the sand and gravel unit intersects the ground surface in the form of standing water. These measurements are correlated with groundwater elevation measurements taken at monitoring wells, and are used to help define groundwater flow direction and gradients in the sand and gravel unit in areas where monitoring well coverage is sparse or nonexistent.

Groundwater Monitoring Program Highlights 1982 Through 2003. Program content is dictated by regulatory requirements in conjunction with current operating practices and historical knowledge of previous site activities.

• Groundwater monitoring at the WVDP began in 1982 with sampling for tritium in the sand and gravel unit in the area of the lagoon system.

• By 1984, 20 wells in the vicinity of the main plant and the NDA provided monitoring coverage.

• Fourteen new wells, a groundwater seep location, and the french drain outfall were added in 1986 to monitor additional site facilities.

• In 1990, 96 new wells were installed for data collection for the environmental impact statement and RCRA facility investigations.

• A RCRA facility investigation expanded-characterization program was conducted during 1993 and 1994 to fully assess potential releases of hazardous wastes or constituents from on-site SSWMUs. This investigation, which consisted of two rounds of sampling for a wide range of radiological and chemical parameters, provided valuable information regarding the presence or absence of groundwater contamination near each SSWMU and was also used to guide later monitoring program modifications.

• In 1993, monitoring results indicated elevated gross beta activity in groundwater in the sand and gravel unit on the north plateau. Subsequent investigation of this area delineated a plume of contamination with a southwest to northeast orientation. (See Special Groundwater Monitoring [p. 4-12] for more detail.)

• Long-term monitoring needs were the focus of a 1995 groundwater monitoring program evaluation. After a comprehensive assessment, the number of sampling locations was reduced from 91 to 65 and analytical parameters were tailored for each sampling location for a more focused, efficient, and cost-effective program.

• In 1996, several groundwater seep monitoring locations on the northeast edge of the north plateau were added to the monitoring program.

• From 1996 through 2003, in response to current sampling results and DOE and RCRA monitoring requirements, specific monitoring locations, analytes, and sampling frequencies were modified.

• Four new groundwater monitoring wells were installed during August 2003 in the vicinity of the remote-handled waste facility (RHWF). Two of the new wells provide monitoring coverage upgradient of the RHWF in the sand and gravel and unweathered Lavery till units. The two remaining new wells, in conjunction with existing wells, provide downgradient coverage of the RHWF within hydrogeologic units. Initial sampling of the new wells took place as part of the fourth-quarter 2003 monitoring event to establish pre-operational conditions. Initial monitoring parameters included radiological indicators; Title 6 of the New York Official Compilation of Codes, Rules, and Regulations (NYCRR), Appendix 33 volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals; and selected radioisotopes.

Annual Analytical Trigger Level Review. A computerized data-evaluation program using “trigger levels” for chemical and radiological analytes was instituted in 1995. These pre-set levels – conservative values for chemical or radiological concentrations – were developed to identify and expedite a prompt focus on any anomalies in monitoring results. These values are based on regulatory limits, detection limits, or statistically-derived levels. Trigger levels are reviewed and updated annually. Upper and lower trigger levels for groundwater elevation measurements were introduced in 1999.

Results of Routine Groundwater Monitoring

Tables in Appendix E[C] group the results of groundwater monitoring within the five hydrogeologic units monitored: the sand and gravel unit, the Lavery till-sand unit, the weathered Lavery till unit, the unweathered Lavery till unit, and the Kent recessional sequence. These tables contain results of sampling for radiological and nonradiological analytes. In addition, Table E-14[C] lists the practical quantitation limits (PQLs) for individual NYCRR Title 6, Appendix 33 analytes. The PQL is the lowest level of an analyte that can be measured within specified limits of precision during routine laboratory operations (New York State Department of Environmental Conservation, 1991).

Appendix E[C] tables also provide each well’s hydraulic position relative to other wells within the same hydrogeologic unit. Wells identified as UP refer to either background wells or wells that are upgradient of other wells in the same hydrogeologic unit. Wells identified as DOWN are downgradient of other wells in that unit. In each table, wells are presented from upgradient to furthest downgradient. Grouping the wells by hydraulic position provides the basis for presenting groundwater monitoring data in the tables and figures in this report.

Data Tables. Groundwater monitoring data for 2003 are presented in Tables E-2 through E-13[C] in Appendix E[C]. Where positive results were obtained, a bolding convention was applied to the data series indicating the high and low values, with a "positive" defined as a result exceeding the PQL for the particular analysis. Additional details regarding the bolding convention are presented on page E-2[C].

Trend-Line Graphs. Trend-line graphs are shown for monitoring locations that have historically shown radiological concentrations above background values, or VOC or SVOC concentrations above PQLs.

Using a Datalogger to Record Hydraulic Conductivity Data From an On-Site Monitoring Well

Long-Term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations. Figures 4-5 through 4-8 (pp. 4-16 and 4-17) show the trends of gross beta and tritium concentrations at selected monitoring locations in the sand and gravel unit. Use of a logarithmic scale allows locations having widely differing concentrations to be compared to average background concentrations plotted on each graph.

Gross Beta. The groundwater plume of gross beta activity in the sand and gravel unit on the north plateau (Fig. 4-3 [*facing page*]) continues to be monitored closely. The source of the plume's activity can be traced to the subsurface beneath the southwest corner of the former process building. In 2003, 11 wells (104, 105, 111, 408, 501, 502, 801, 8603, 8604, 8605, and 8609) showed gross beta concentrations that exceeded the DOE derived concentration guide (DCG) for strontium-90 (1.0E-06 µCi/mL). Lagoon 1, formerly part of the low-level waste treatment facility, has been identified as a source of the gross beta activity at wells 8605 and 111.

• Figures 4-5 and 4-6 (p. 4-15) show gross beta in wells 408, 501, 502, 8604, and 8609 (which are somewhat centrally located on the north plateau and are closer to the plume's suspected source beneath the main plant) and wells 104, 105, 116, 801, and 8603 (which are located generally further northeast, nearer the leading edges of the gross beta plume), respectively. As in previous years, samples from well 408 continued to show the highest gross beta concentrations of all the wells within the north plateau gross beta plume

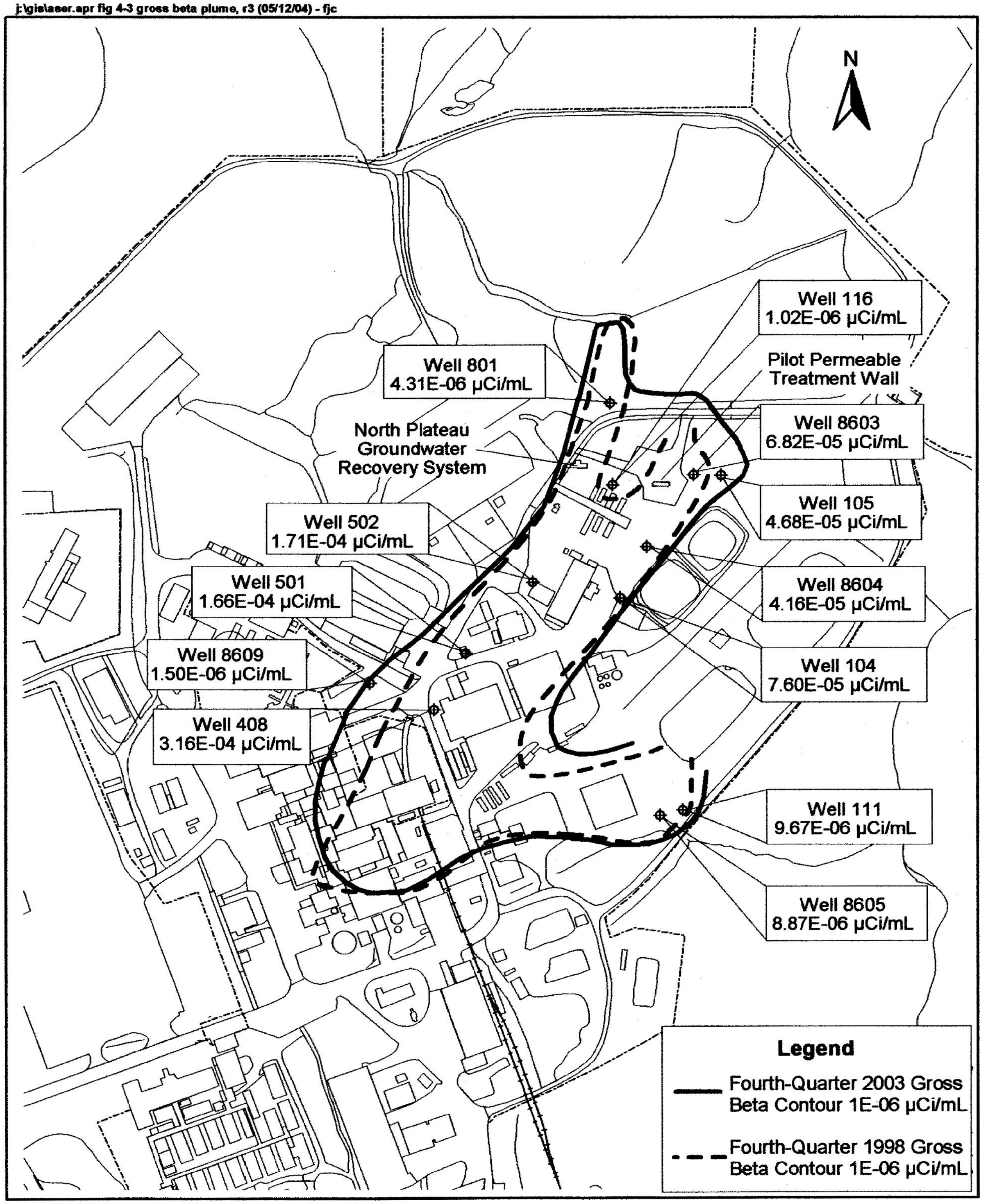

Figure 4-3. North Plateau Gross Beta Plume Area: Fourth-Quarter 2003 Results

area. Gross beta results for well 408 in 2003 were somewhat lower than 2002 results.

Wells 501, 502, and 801 showed slight decreases relative to 2002. Wells 104, 105, 116, 8603, 8604, and 8609 showed increases relative to 2002 values. Well 105 shows the largest overall increase over the last ten years.

• Figure 4-7 (p. 4-17) is a graph of gross beta concentrations at sand and gravel unit monitoring locations 111 and 8605, located near the eastern edge of the north plateau adjacent to former lagoon 1. Gross beta concentrations at well 111 were slightly higher in 2003 than in 2002. In well 8605, gross beta results for 2003 were similar to 2002 results, but overall a decreasing trend is evident from 1994 to the present.

Tritium. Tritium in sand and gravel wells also is routinely monitored as part of the groundwater program.

• Figure 4-8 (p. 4-17) shows the tritium concentrations in wells 111, 8603, 8604, 8605, and 8609. The figure indicates that tritium concentrations in these wells mainly show slight decreases or relatively consistent trends. Well 111 has had slight increases during the last two years.

North Plateau Seeps. Analytical results of sampling for radiological parameters from the sand and gravel unit seepage monitoring locations were compared with results from GSEEP, a seep monitored since 1991 that has not been affected by the gross beta plume. (Seep monitoring locations are noted on Figs. A-6 and A-7 [pp. A-6 and A-7].)

Gross Beta. Radiological monitoring results continue to indicate that the gross beta groundwater plume has not migrated to these seepage areas. With the exception of SP11, gross beta concentrations from all seep monitoring locations were less than or similar to GSEEP concentrations during 2003. Gross beta concentrations at SP11 show a slightly increasing trend since early 1999 and somewhat steeper increases during 2001 through 2003. Contamination observed at SP11 is believed to be attributable to re-infiltration of contaminated water that has surfaced from the strontium-90 groundwater plume. Although somewhat greater than values typically obtained at GSEEP, it is still well below the strontium-90 DCG. (See Table E-7[C].)

Gross Alpha. Gross alpha concentrations at all of the seep sampling locations were very low – generally below the associated uncertainty or less than the detection limit.

Tritium. Tritium concentrations at the seeps remained similar in magnitude or were less than concentrations at GSEEP. Tritium concentrations in the north plateau seeps, including GSEEP, are slightly above levels reported in background wells of the sand and gravel unit. Concentrations are similar to those seen in sand and gravel unit wells monitoring the lagoon areas of the north plateau, but are still far below the DCG for tritium.

North Plateau Well Points. Sampling at well points A, C, and H (Fig. A-6 [p. A-6]) monitors tritium concentrations in the area east of the process building and fuel receiving and storage facility and west of former lagoon 1. Samples from these three locations have yielded concentrations of tritium that, while elevated with respect to historical monitoring of wells in the area, are well below the DCG of 2.0E-03 µCi/mL. (See Table E-8[C].) Data from downgradient monitoring wells have not indicated similarly elevated levels of tritium.

Results of Radioisotopic Sampling. Groundwater samples for radioisotopic analyses are collected regularly from selected monitoring points in the sand and gravel unit and the weathered

Lavery till. (See Table E-13C.) Results in 2003 were generally similar to historical findings. Strontium-90 remained the major contributor to elevated gross beta activity in the plume on the north plateau, as indicated by the similarity between strontium-90 trends and gross beta trends in wells showing elevated gross beta results.

Carbon-14, technetium-99, and iodine-129, which have been detected at several monitoring locations at concentrations above background levels, contribute very small percentages to total gross beta concentrations. These detections have occurred at locations within the gross beta plume and downgradient of former lagoon 1 and the NDA. None of the concentrations of carbon-14, technetium-99, or iodine-129 have been above DCGs, and gross beta analyses continue to provide appropriate trend surveillance on a quarterly basis.

Results of Monitoring at the NDA. A trench system was constructed along the northeast and northwest sides of the NDA to collect groundwater that may be contaminated with a mixture of n-dodecane and tributyl phosphate (TBP). (See also Chapter 1, Environmental Program Information, NRC-Licensed Disposal Area [NDA] Interceptor Trench and Pretreatment System [p. 1-11].) There were no monitoring results in 2003 that indicated the presence of TBP or n-dodecane in groundwater in the vicinity of the NDA. Groundwater levels are monitored quarterly in and around the trench to ensure that an inward gradient is maintained, thereby minimizing outward migration of potentially-contaminated groundwater.

Gross beta and tritium concentrations in samples from location WNNDATR, a sump at the lowest point of the interceptor trench, and from well 909 (Fig. A-6 [p. A-6]), which is downgradient of WNNDATR, continued to be elevated with respect to background monitoring locations on the south plateau but were still well below the DCGs.

WNNDATR. During 2003, gross beta concentrations at WNNDATR were similar to those seen during 2002, but tritium, while still higher than at other NDA monitoring locations, shows an overall decrease.

Well 909. Radiological indicator results have historically fluctuated at this location but, in general, upward long-term trends in both gross beta and tritium were discernible at well 909 until 1999, when both trends declined, followed by relatively consistent results during recent years. Gross beta concentrations from well 909 are somewhat higher than at NDATR. Residual soil contamination near well 909 is the suspected source of elevated gross beta concentrations.

Off-Site Groundwater Monitoring. Groundwater is used as a potable water supply at off-site private residences near the WVDP. Nine off-site residential supply wells located within 4.3 miles (7 km) of the facility were sampled for radiological parameters in 2003. A tenth private well, located 18 miles (29 km) south of the site, provided a background location. These monitoring results are discussed in Chapter 2 (p. 2-12), Overview of Drinking Water Monitoring.

Results for Volatile and Semivolatile Organic Compounds. VOCs and SVOCs were sampled at specific locations (wells 8612, 8609, 803, 8605, 111, and seep sampling location SP12 [Fig. A-6, p. A-6]) that have shown historical results above their respective practical quantitation limits. (See Table E-14C for a list of PQLs.) Other monitoring locations are sampled for VOCs and/or SVOCs because they are downgradient of locations that have shown positive results or to comply with the RCRA §3008(h) Administrative Order on Consent.

1,1-Dichloroethane (1,1-DCA). Concentrations of 1,1-DCA at well 8612 decreased during 1995–1998 and then leveled off during 1999–2003. (See

Fig. 4-9 [p. 4-18].) The compound was not detected at wells 8609, 803, or groundwater seep SP12 during 2003. (See Table E-9C.)

Dichlorodifluoromethane (DCDFMeth). DCDFMeth was detected at wells 803 and 8612 during 2003 at estimated concentration levels below the PQL. (See Table E-9C.)

1,1,1-Trichloroethane (1,1,1-TCA). The compound 1,1,1-TCA was detected in wells 8609 and 8612 during 2003 at levels below the PQL, but was not detected in well 803 or in seep SP12. (See Table E-9C for VOC concentrations at these locations and Fig. 4-9 [p. 4-18] for a graph of 1,1,1-TCA concentrations at well 8612.)

Total 1,2-Dichloroethylene (1,2-DCE-t). Positive detections of 1,2-DCE-t were first noticed at well 8612 in 1995. Concentrations of 1,2-DCE-t increased from 1995 through 2002, but the trend has leveled from 2002 through 2003, and during 2003 concentrations were similar to or slightly lower than those measured during 2002. (See Fig. 4-9 [p. 4-18].)

The VOCs 1,1-DCA, DCDFMeth, and 1,1,1-TCA are often found in combination with each other and with 1,2-DCE-t. In well 8612, each of these three compounds first exhibited an increasing trend that, over the past few years, was then followed by a decreasing trend. It is expected that 1,2-DCE-t will exhibit similar behavior, and continued routine monitoring will evaluate future trends.

Tributyl Phosphate. Concentrations of TBP were detected in 2003 groundwater samples from well 8605, near former lagoon 1, at concentrations similar to those in 2002, and within the range of historical results. TBP also was previously detected in well 111, located near well 8605, but at levels much lower than those at well 8605. However, there were no positive detections of TBP at well 111 during 2003. (See Figure 4-10 [p. 4-18] and Table E-10C.)

Ongoing detection of TBP in this localized area may be related to previously-detected, positive concentrations of iodine-129 and uranium-232 in wells 111 and 8605, as noted in previous Annual Site Environmental Reports. The presence of these three contaminants may reflect residual contamination from liquid waste management activities in the former lagoon 1 area during earlier nuclear fuel reprocessing. Future trends of TBP will be evaluated as part of the routine groundwater monitoring program.

Special Groundwater Monitoring

Gross Beta Plume on the North Plateau. Elevated gross beta activity has been detected in groundwater from the surficial sand and gravel unit in areas north and east of the building where Nuclear Fuel Services, Inc. reprocessed nuclear fuel (Fig. 4-3 [p. 4-9]). In December 1993, elevated gross beta concentrations were detected in surface water at former sampling location WNDMPNE, located near the edge of the plateau. This detection initiated a subsurface groundwater and soil investigation in 1994 using a Geoprobe® mobile sampling system, which helped to identify the location and extent of the gross beta plume beneath and downgradient of the former process building.

The highest gross beta concentrations in groundwater and soil were found near the southeast corner of the process building. Strontium-90 and its daughter product, yttrium-90, were identified as the major isotopic components of this elevated gross beta activity (WVNSCO, 1995).

In 1995, the north plateau groundwater recovery system (NPGRS) was installed to minimize the advance of the gross beta plume. The NPGRS is located near the leading edge of the western lobe of the plume where groundwater flows preferentially toward the edge of the plateau, seeps into a ditch, and flows as surface water toward monitoring location WNSWAMP. (See Northeast Swamp Drainage Monitoring [*this page*].) The NPGRS consists of three wells that extract contaminated groundwater, which is then treated by ion exchange to remove strontium-90. Treated water is transferred to the lagoon system and ultimately is discharged to Erdman Brook.

The north plateau groundwater recovery system operated successfully throughout 2003, processing about 4.5 million gallons (17.0 million liters). The system has recovered and processed approximately 34 million gallons (128 million liters) since November 1995.

More attention was given in 1998 to the core area of the plume, determined to be beneath and immediately downgradient of the former process building. The 1998 study noted that, while the overall distribution of strontium-90 in groundwater within the plume was similar to 1994, concentrations detected in 1998 samples were generally lower than in 1994 samples, due to radioactive decay and continuing migration and dispersion of the plume (WVNSCO, June 1999).

Permeable Treatment Wall. A pilot-scale permeable treatment wall (PTW) was completed in 1999 in the eastern lobe of the north plateau plume in order to test this passive, in-situ remediation technology. The PTW is a trench constructed in the subsurface and backfilled with clinoptilolite, a medium selected for its ability to adsorb strontium-90 ions from groundwater. The PTW extends vertically downward through the sand and gravel unit to the top of the underlying Lavery till and is approximately 30 feet long and 10 feet wide (9 meters long by 3 meters wide).

Monitoring and evaluation of water levels and radiological concentrations upgradient, within, and downgradient of the PTW continued during 2003 in order to assess its effectiveness. Additional test borings and monitoring well installations were completed in the vicinity of the PTW during the fall of 2001 to obtain improved definition of hydrogeologic conditions. Hydraulic testing in the new wells was completed during 2002. The evaluation concluded that complex hydrogeologic conditions and disturbances from the installation are influencing groundwater flow into and around the pilot PTW.

Northeast Swamp Drainage Monitoring. Routine surface water sampling during 2003 continued to monitor radioactivity levels in surface water flowing through the outlet location WNSWAMP. (See Appendix C[C], Table C-3D[C].) Gross beta and strontium-90 concentrations continued to fluctuate due to seasonal effects. Annualized average strontium-90 concentrations steadily decreased during most of the year, dropping below the DOE DCG by about mid-summer. (See Fig. 4-4 [p. 4-14].) This decreasing trend may be due to a combination of factors, including the operation of the NPGRS, which removes groundwater containing strontium-90 from the subsurface, thereby decreasing the amount of radioactivity migrating to WNSWAMP, and dilution (from groundwater recharge and surface runoff) of any existing radioactivity present in the subsurface prior to NPGRS operations. The main source of the elevated strontium-90 is seepage of groundwater affected by the north plateau plume into a ditch upstream of WNSWAMP.

Although the annualized average concentration of strontium-90 in surface water decreased at sampling location WNSWAMP (on the WVDP premises), concentrations remained elevated with respect to background. Even so, monitoring downstream at the first point of public access (WFFELBR) continued to show strontium-90 concentrations that were not significantly different from background (WFBIGBR) concentrations. (See also Northeast Swamp and North Swamp Drainage [p. 2-6] in Chapter 2, Environmental Radiological Program Information.)

North Plateau Groundwater Quality Early Warning Monitoring. Early-warning monitoring of water recovered by the NPGRS is important because this water is ultimately discharged off-site via the New York State Pollutant Discharge Elimination System (SPDES) outfall 001. Quarterly monitoring results from well 502, located directly upgradient of the NPGRS, can be used to identify analytical concentrations in groundwater that may affect compliance with the SPDES-permitted effluent limits. Results of sampling for metals at well 502 can be found in Tables E-11 and E-12[C].

Investigation of Chromium and Nickel in the Sand and Gravel Unit and Evaluation of Corrosion in Groundwater Monitoring Wells. A 1997 and 1998 study of the effect of modifying sampling equipment and methodology on concentrations of chromium and nickel in samples of groundwater from the sand and gravel unit noted that such modifications did produce decreases in chromium and nickel concentrations. This supported the hypothesis (which is documented in the technical literature) that elevated concentrations were not representative of actual groundwater conditions, but were caused by release of metals from subsurface corrosion of stainless-steel well materials (WVNSCO and Dames & Moore, June 1998).

To ensure continued monitoring-well integrity and collection of high-quality samples representative of actual groundwater conditions, wells are periodically inspected for corrosion. Approximately three-fourths of the stainless-steel wells monitoring the sand and gravel unit were internally inspected for corrosion during 2001. Wells containing corrosion were cleaned using simple brushing and purging techniques. Cleaned wells were reinspected to verify that corrosion had been removed.

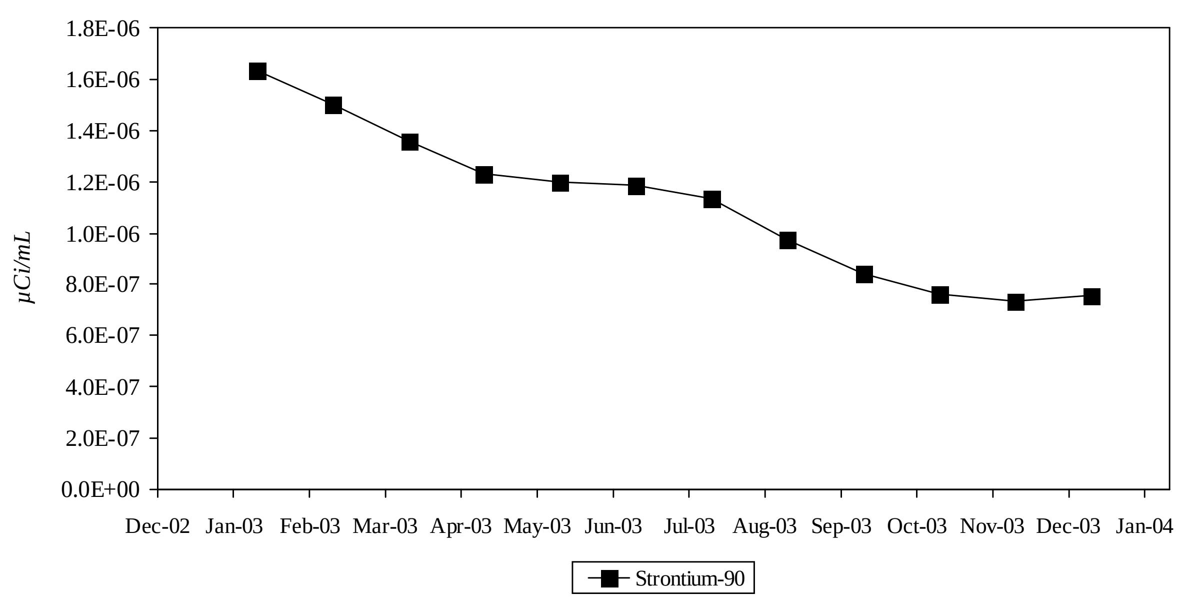

Figure 4-4. Annualized Average Strontium-90 Concentrations at WNSWAMP

Ten-Year Sampling Pump Inspections. Dedicated bladder pumps were installed in many WVDP monitoring wells in 1991. (See Groundwater Sampling Methodology [Appendix E[C], p. E-2].) Pumps in all actively sampled wells were removed and inspected during 2001 to evaluate pump conditions after ten years of use. All pumps were found to be in good, serviceable condition during the 2001 inspection and during routine quarterly sampling activities in 2002 and 2003.

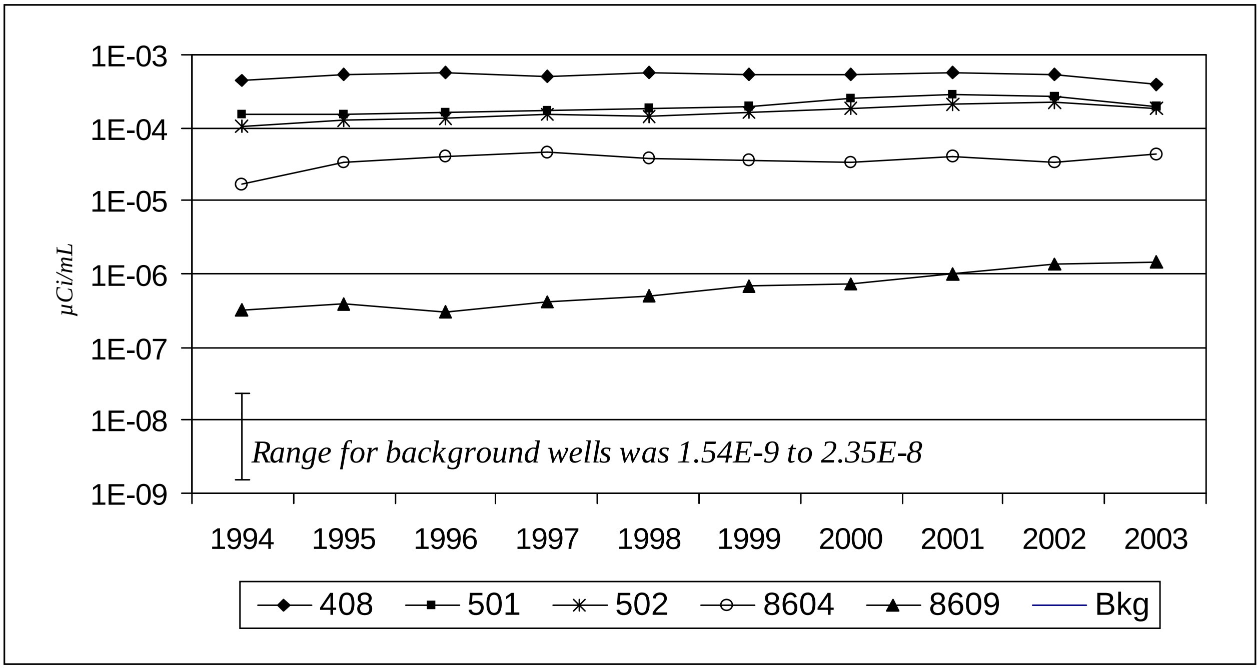

Figure 4-5. Average Yearly Gross Beta Concentrations at Selected Locations in the Sand and Gravel Unit

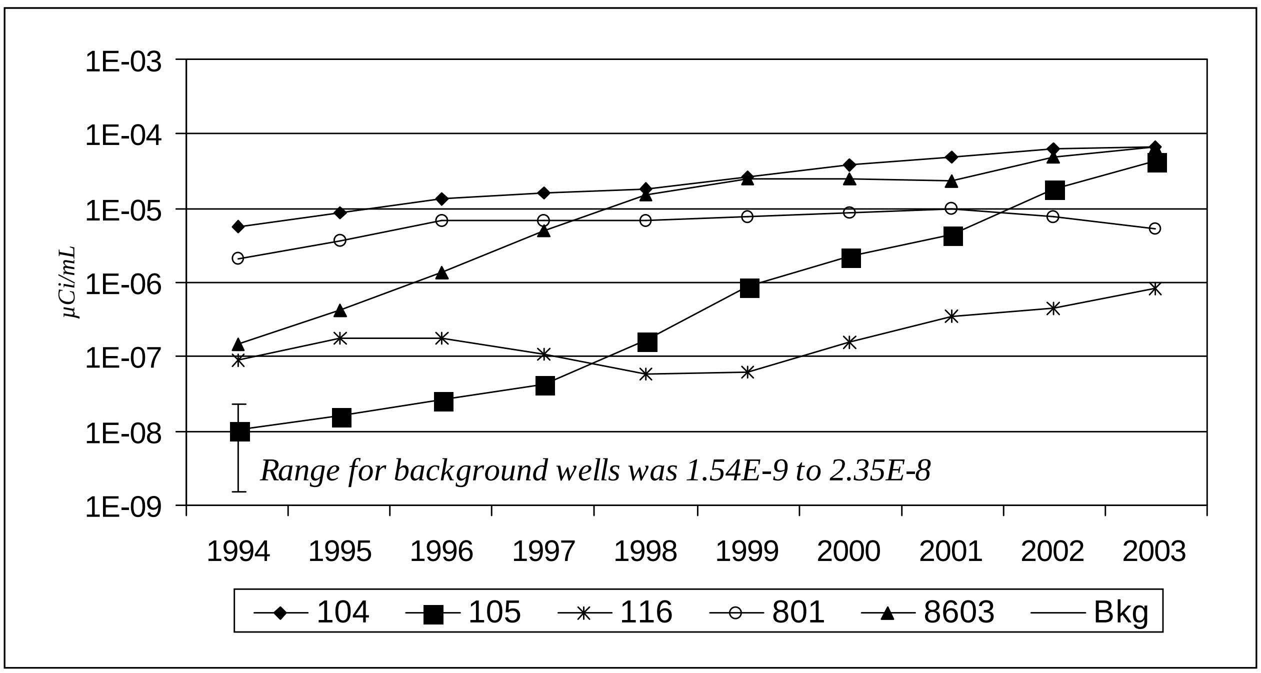

Figure 4-6. Average Yearly Gross Beta Concentrations at Selected Locations in the Sand and Gravel Unit

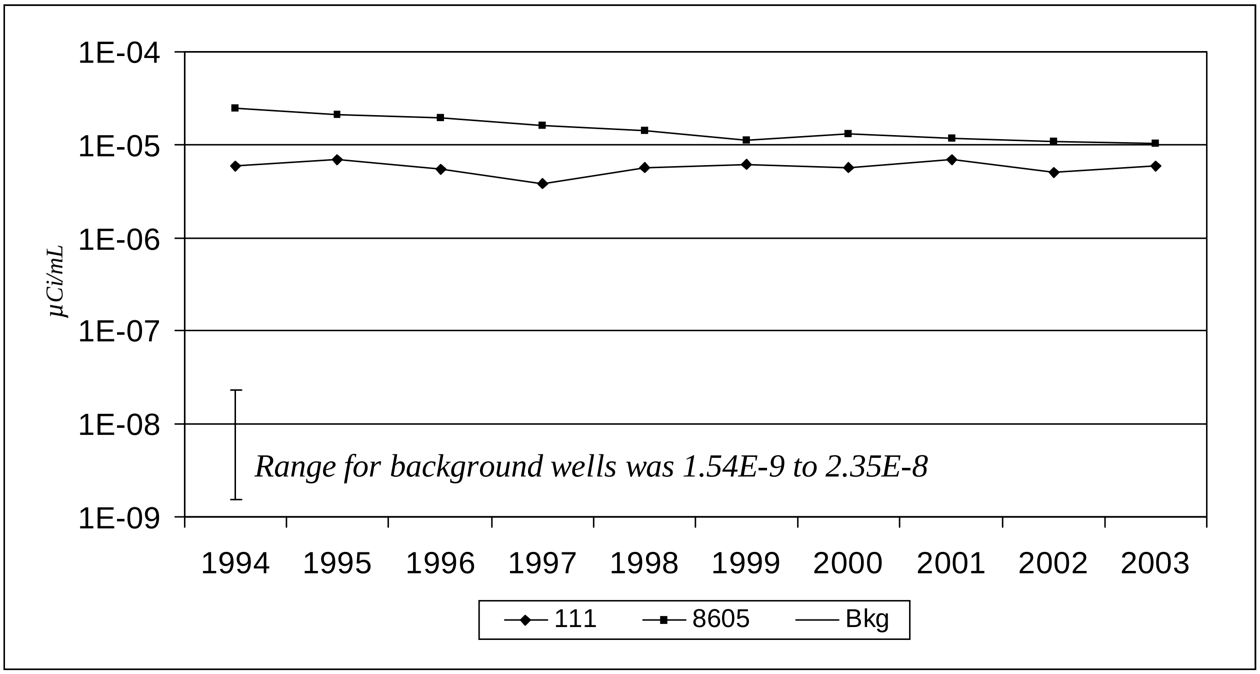

Figure 4-7. Average Yearly Gross Beta Concentrations at Selected Locations in the Sand and Gravel Unit

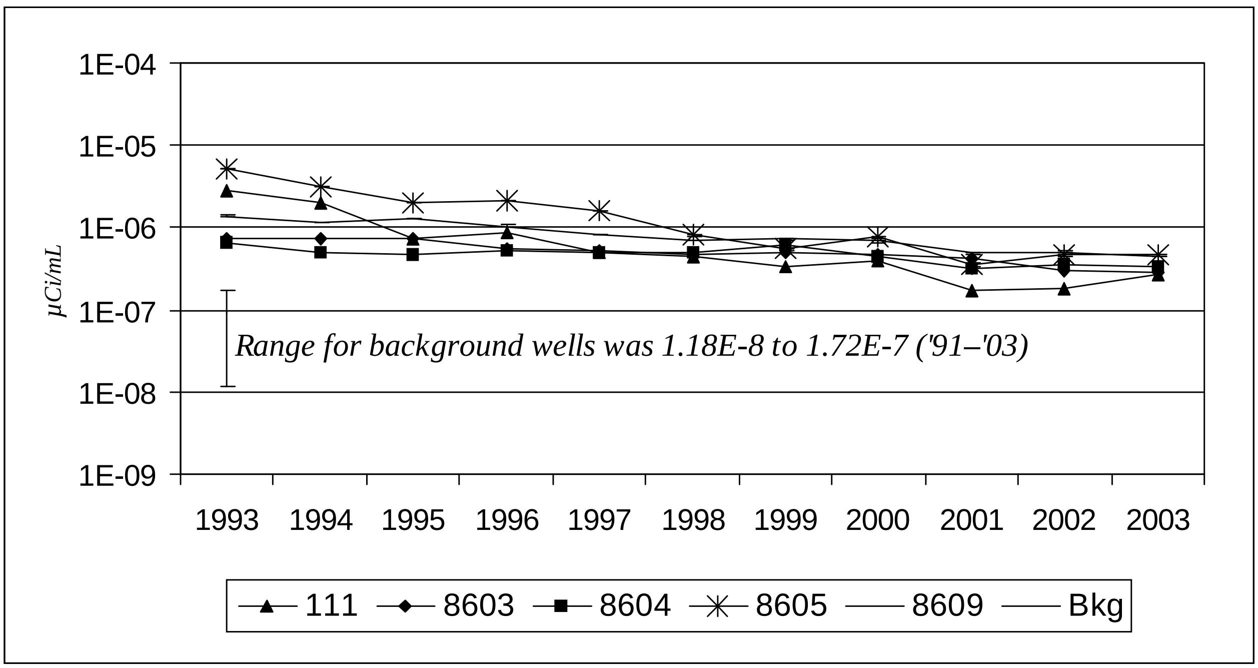

Figure 4-8. Average Yearly Tritium Concentrations at Selected Locations in the Sand and Gravel Unit

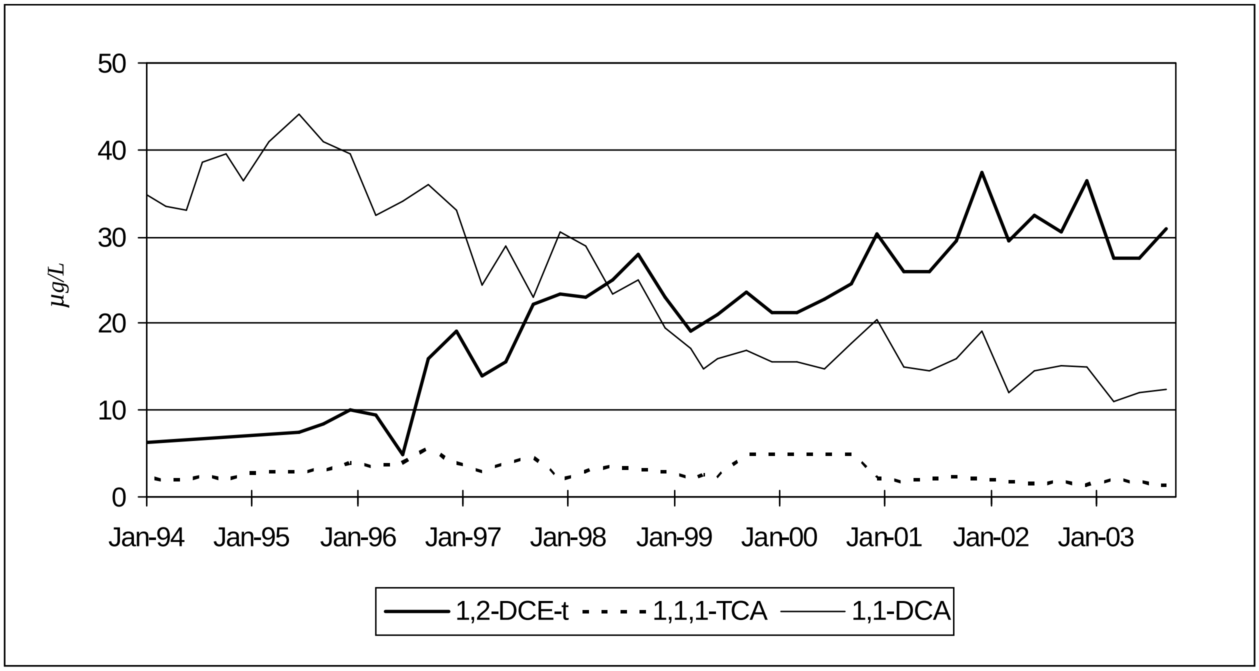

Figure 4-9. Concentrations of 1,2-DCE-t, 1,1,1-TCA, and 1,1-DCA at Well 8612 in the Sand and Gravel Unit

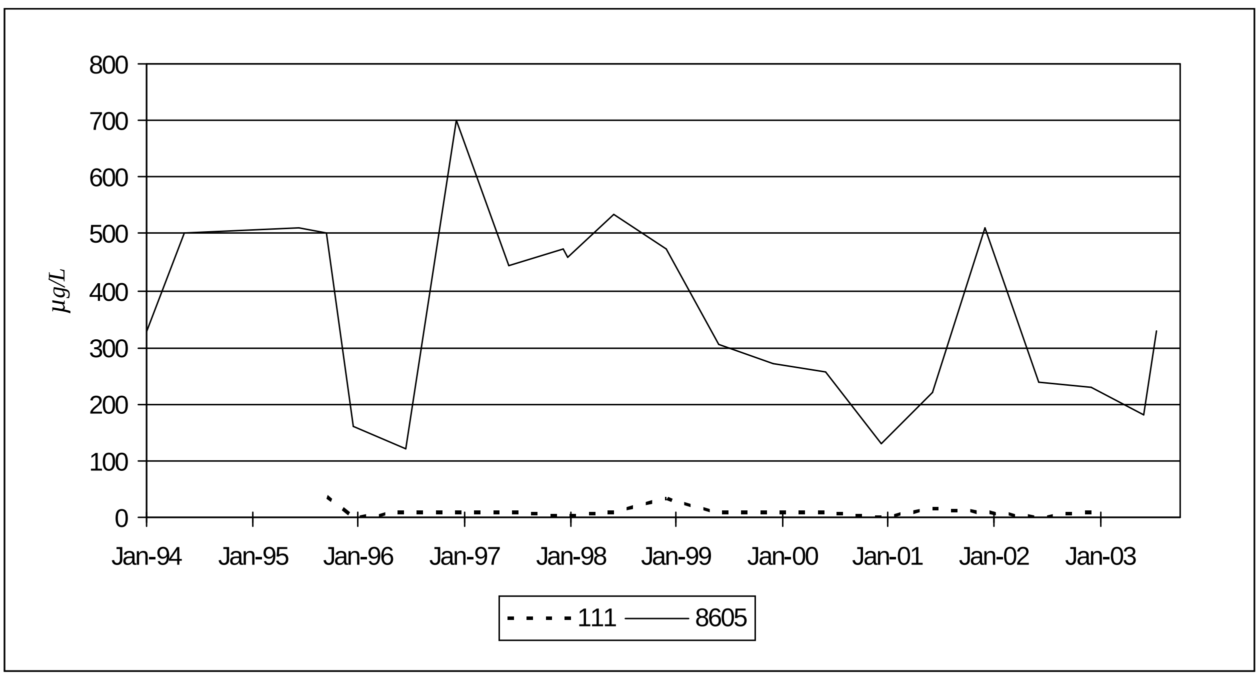

Figure 4-10. Concentrations of Tributyl Phosphate at Selected Locations in the Sand and Gravel Unit